East of England Children & Young People's (CYP) Diabetes Network

Management of Children and Young people with Diabetes (Age >6months-18th birthday) Requiring Surgery and Other Procedures

Where young people aged 16-18 years are managed by adult medical teams because of local arrangements, it is considered appropriate for them to be managed using local adult guidelines that the teams are familiar with rather than using potentially unfamiliar paediatric guidelines.
Where individuals aged 16-18 are managed by paediatric teams the paediatric guidelines should be followed.

Early and Effective communication

- Surgeon/physician communicates with the diabetes team as soon as the decision to undertake the surgery/procedure is made.
- Surgeon/physician fills in the pre-operative information sheet (appendix 3) and sends it to the diabetes team.

Role of the Diabetes Team

- Tries to optimise pre-operative diabetes control.
- Selects and completes the appropriate individualised care plan (page 2) and files in the hospital notes.
- Provides appropriate information leaflet regarding pre-operative adjustment of insulin (appendix 4 or 5) to CYP/ parents.

Admission and Discharge planning

- Ward/Acute Area nurse goes through the admission check list (appendix 7) and file the individualised care plan in the front of the hospital notes.
- Anaesthetist follows the individualised care plan in the theatre and during recovery.
- Ward/Acute Area nurse continues to follow individualised care plan on CYP return to the ward.
- At discharge the Ward/Acute Area nurse provides appendix 8 to CYP/parents and liaises with diabetes team.

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Management of Children and Young People with Diabetes Requiring Surgery and Other Procedures

1 Background

During surgery or other procedures under sedation or anaesthesia, the aim is to maintain near normal glycaemic control with optimal hydration and serum electrolytes, to avoid hypoglycaemia and prevent catabolism and ketoacidosis by ensuring optimum insulin delivery. This guideline is based on the International Society of Paediatric and Adolescent Diabetes (ISPAD) clinical practice consensus guidelines[1, 2]. Modifications have been made in light of recently published document 'Management of adults with diabetes undergoing surgery and elective procedures'[3] and from the evidence published in the anaesthetic literature[4]. Trust staff using this guideline must ensure that local infection prevention & control policies are adhered to ensure patient safety relating to e.g. covid-19.

2 Purpose & Scope

- This guideline is for use in children and young people with diabetes, over 6 months of age until the 18th birthday for patients admitted to hospital for surgery and procedures including sedation in the paediatric or adult wards/day services.
- To be available in all units within the East of England CYP Diabetes Network to ensure that quality of care is high and standardised.
- Where young people aged 16-18 years are managed by adult medical teams because of local arrangements, it is considered appropriate for them to be managed using local adult guidelines that the teams are familiar with rather than using potentially unfamiliar paediatric guidelines. Where individuals aged 16-18 are managed by Paediatric teams the Paediatric guidelines should be followed.

3 Definitions

The definitions used below have been adopted from the document 'Management of adults with diabetes undergoing surgery and elective procedures'[3]

3.1 Variable rate intravenous insulin infusion (VRIII):

Replaces the term 'Sliding Scale' for an intravenous insulin infusion that is titrated to the patient's blood glucose (appendix 1). VRIII is usually required during emergency surgery or for procedures requiring more than one missed meal e.g., breakfast and lunch. For safer administration of VRIII follow instruction on appendix 1.

3.2 Anticipated starvation period requiring more than one missed meal:

If the peri- operative starvation period is likely to be long and is likely to involve more than one missed meal, or a period of pre-operative diet change to facilitate bowel prep or delay in resumption of normal intake post operatively. In these circumstances a VRIII (section 7.6) will most likely be required.

3.3 Anticipated starvation period requiring one missed meal:
If the planned starvation period (includes the total of pre-anaesthetic and post-anaesthetic missed meals) is short and generally less than 12 hours, the CYP can be managed by modification of their usual subcutaneous insulin, thus avoiding a VRIII whenever possible. In practice this means that patients should be first on a morning or an afternoon list, and able to resume a normal oral intake after the procedure, so that they only miss either breakfast or lunch.

3.4 Anticipated starvation period not requiring a missed meal (delayed meal):
CYP requiring anaesthesia/sedation for a maximum of 30 minutes and rapid recovery is anticipated (ideally early morning cases): these can be managed by delaying the morning dose of insulin or discontinuing an insulin pump until immediately after completion of the procedure.

4 Glycaemic Targets for Surgery

It has been shown that sub-optimal glycaemic control in the peri-operative period has a significant impact on the risk of post-operative infection in adults[5,6,7]. There is a lack of quality evidence of peri-operative blood glucose and outcome in CYP with diabetes undergoing surgery. The ISPAD clinical practice consensus guidelines[1] suggest keeping capillary blood glucose (CBG) levels between 5 and 10mmol/L during surgical procedures in children. ***To minimise the risk of hypoglycaemia or hyperglycaemia, our consensus for this guideline is to aim for a CBG of 5-10mmol/L in the peri-operative period. So in the peri-operative period, treatment for hypoglycaemia is required if BG level is <5mmol/L.***

For the purpose of this guideline hyperglycaemia is defined as CBG >13.9 mmol/L. A CBG <10mmol/L is desirable, but it is recognised that blood glucose often remains slightly elevated in the post-operative period secondary to the stress response to surgery[5]. ***So we advocate correction of high blood glucose if the CBG > 13.9 mmol/L for children on S/C insulin and not on VRIII (for those on variable rate intravenous insulin infusion (VRIII) the insulin adjustment as per VRIII will have to be followed).***

5 General Recommendations

5.1 Planning

Careful planning and good communication between the surgeon or physician undertaking the procedure, the anaesthetists, diabetes team and the Ward/ Acute Area staff is essential for successful surgery and outcome, appendix 2.

- **Effective communication:** It is recommended that the surgeon/physician and anaesthetist should communicate with the diabetes team as soon as the decision is made to undertake the surgery/procedure by filling in the pre-operative information sheet, appendix 3 and sending it to the CYP's diabetes team.

- **Role of the diabetes team:** The diabetes team should assess pre-operative diabetes control and should help the CYP to improve their diabetes control before surgery/procedure. Diabetes team selects and completes the appropriate individualised care plan (section 7) and files a copy in the notes. The diabetes team gives and explains the appropriate information leaflet regarding pre-operative adjustment of insulin, appendix 4 or appendix 5 to the parents/ patient. 'Quick Guide' regarding adjustment of insulin before surgery is also provided in appendix 6.

- **Admission and discharge planning:** The Ward/Acute Area nurse responsible for the care of the CYP during the admission should go through the suggested check list before surgery, appendix 7 . The anaesthetist follows the individualised care plan in the theatre and during recovery. The discharging nurse provides appendix 8 (Advice for CYP with diabetes who are discharged following surgical procedure) to the parents/CYP and liaises with the diabetes team regarding follow-up.

5.2 Commonly used insulin preparations

- For commonly used insulin preparations see appendix 6.

5.3 Capillary blood glucose monitoring

- The CBG should be monitored hourly as a minimum. In the young children (<3 years), in those undergoing major surgery and in those where the CBG is <6mmol/L with a decreasing blood glucose trend it should be half hourly. **The use of CGM to monitor blood glucose may not be accurate and should be used with caution.**

5.4 Hypoglycaemia

Hypoglycaemia is usually defined as CBG <4mmol/L. However for the purpose of this guideline the consensus is to treat any CBG < 5mmol/L as follows:

5.4.1 If intravenous insulin is running, stop this and contact the duty doctor (recommence IV insulin infusion once CBG > 6mmol/L).

5.4.2 If IV access is in situ give 2.0ml/kg of 10% glucose over 5 minutes. Repeat if required.

5.4.3 If there is no IV access and the patient is conscious, give 40% Glucose gel (1 tube contains 10 gram of rapid acting glucose): < 9 years (or < 25kg) ½ tube and = > 9 years(or >25kg) 1 tube)

5.4.4 If the CYP is unconscious and no IV access give IM Glucagon: Dose: < 9yrs (or <25kg) 0.5mg; = > 9yrs (or >25kg) 1mg [17] .

5.4.5 Retest CBG after 15 minutes. **If CBG 5-6mmol/L, monitor CBG half hourly**. If the trend is downward or the CYP is symptomatic consider treatment as above.

5.5 Hyperglycaemia

For the purpose of this guideline hyperglycaemia is defined as CBG >13.9mmol/L. A CBG <10mmol/L is desirable, but it is recognised that blood glucose often remains slightly elevated in the post-operative period secondary to the stress response to surgery.

So for children on S/C insulin and not on VRIII, we advocate correction of high blood glucose if the CBG is greater than 13.9 mmol/L, as follows:

- Give rapid acting insulin as per insulin sensitivity factor (page 8). If on insulin pump give correction bolus using pump bolus calculator.
- If after 2 hours CBG is still above 13.9 mmol/L, check blood ketones and correct elevated blood glucose with rapid acting insulin as above.

- The CYP should be monitored carefully for the risk of developing diabetic ketoacidosis (DKA) and inform the diabetes team.

If on variable rate intravenous insulin infusion (VRIII) follow the instructions on the VRIII plan (section 7.6)

5.6 Parenteral maintenance fluids (PMF)

- The standard intravenous fluid to run alongside the VRIII is 5% glucose in 0.9% saline with 10 mmol KCl in a 500ml bag[15].
- **If a VRIII is not used, fluids should be administered according to the anaesthetist's normal practice (preferably without containing glucose).**
- Monitor electrolytes daily to avoid hyponatremia.
- If hyponatremia develops despite using 0.9% saline containing fluids, discuss with the diabetes team.
- **The fluid infusion rate is calculated according to body weight using the Holliday- Segar nomogram (100ml/kg/day for the 1st 10kg body weight, 50ml/kg/day for the 2nd 10kg of weight, 20ml/kg/day for the remaining weight). This may be an overestimate of fluid requirement.**
- Should additional peri-operative fluids be required, boluses of fluids such 0.9%saline /Hartmann's fluid (according to the practice of the individual anaesthetist) can be co-administered as required.
- Further information is found in appendix 9.

5.7 Emergency Surgery

- There is no opportunity for pre-admission planning in CYP having emergency surgery. The patient may have taken their normal insulin doses and therefore intravenous fluids should be started and the CBG should be closely monitored to prevent the risk of hypoglycaemia. Start variable rate intravenous insulin infusion (appendix 1) and continue intravenous fluids containing dextrose, appendix 9 .

- Check weight (if possible), serum electrolytes, capillary gases, and blood ketones before anaesthesia.

- If DKA is present, follow EOE CYPDN DKA ICP, based on British Society of Paediatric Endocrinology and Diabetes (BSPED) guidelines[8] for management of DKA and delay surgery until circulating volume and deficits are corrected.

5.8 Insulin pump therapy/continuous subcutaneous insulin infusion (CSII)

- It is recommended that if possible CYP on CSII should continue on pump therapy during the surgery/procedure (as long as there is a health care professional present who is insulin pump proficient).

- For procedures requiring one missed meal, pump therapy should be continued and the CYP should remain on their basal rates (section 7.3).

- For procedures requiring very short anaesthesia, CSII can be discontinued up to a **maximum of 60 minutes** and CBG monitored before and after the procedure. This decision will be taken by the operating surgeon and the attending anaesthetist jointly and documented in the notes. **DO NOT forget to recommence CSII IMMEDIATELY after the procedure (failure to do this is a critical incident).**

- The anaesthetic team may choose to convert CSII to a VRIII during surgery to allow finer control in the peri-operative period (or if there isn't a health care professional present who is pump proficient)

- If the CSII has been discontinued and replaced with VRIII, the CSII should be restarted once the CYP is ready to eat and VRIII should be **discontinued 60 minutes after the first mealtime bolus** has been given through the pump.

5.9 Safer administration of insulin

- All regular and single insulin (bolus) doses are measured and administered using an insulin syringe or commercial insulin pen device. **Intravenous syringes should NEVER be used for insulin administration.**

- The term **'units'** is used in all contexts. Abbreviations, such as 'U' or 'IU', should **NOT** be used while prescribing.

- An insulin syringe must be used to measure and prepare insulin for an intravenous infusion. Intravenous infusions are administered in 50ml luer-lock intravenous syringes- see appendix 1 .

- When an intravenous insulin infusion is used, fluids containing glucose should be infused continuously until the patient is eating and drinking.

- The first choice of fluids should be 5% glucose in 0.9 % saline with 10 mmol KCl in a 500ml bag, appendix 9 .

- ***If CBG drops below 5 mmol/L then insulin infusion can be stopped temporarily but only for 10-15 minutes (recommence IV insulin infusion once CBG > 6mmol/L). Check if the insulin infusion has been made up correctly or change and make new insulin infusion.***

6 Insulin sensitivity factor (ISF) or Insulin correction factor (ICF)

ISF helps to calculate the dose of rapid acting insulin required to correct high blood glucose above1mmol/L. ISF can be calculated by using the rule of 100 (see example below). *The diabetes team should calculate ISF before surgery and write on the individualised care plan:*

EXAMPLE

Rule of 100:

Divide 100 by total daily dose, e.g. if total daily dose is 50 units (100 ÷ 50 = 2). This means that 1 unit of rapid acting insulin (Humalog® or NovoRapid®), would drop CBG by 2mmol/L. (i.e., ISF = 2).

Aim to drop CBG to 10mmol/L. Example:

If CBG= 16, target CBG =10 and ISF=2 (Actual CBG – Target CBG) ÷ ISF

(16 – 10) ÷ 2, 6 ÷ 2 = 3

Patient would need 3 units of rapid acting insulin to drop CBG from 16 to 10mmol/L.

Always check CBG 2 hours after the correction dose of rapid acting insulin.

7.1 INDIVIDUALISED PERI-OPERATIVE CARE PLAN- ONE MISSED MEAL -MANAGEMENT OF MULTIPLE DAILY INJECTIONS INSULIN REGIME

Usual type of insulin: **Mixed insulin:** **Rapid acting insulin:**	CBG	Insulin dose Max 2hrly Unless using Smart meter/App	Addressograph
	13.9 mmol/L to _____ mmol/L	Units	**Surname:**
Management of high blood glucose levels. **ISF:** 1 unit of rapid acting insulin will lower CBG by _____ mmol/L. Or use Pump,SMART meter or App.	_____ mmol/L to _____ mmol/L	Units	**First Name:** **DOB:**
	_____ mmol/L to _____ mmol/L	Units	**Hosp No:**
Form filled in by:	_____ mmol/L to _____ mmol/L	Units	**NHS No:**
Procedure:			

The Night before Surgery

CYP should receive basal insulin as usual; consider reducing the evening basal insulin if there is a pattern of low CBG in the preceding 3 to 4 mornings (appendix 6).

On the Day of Surgery

Write the plan here, (appendix 6)

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Caution: If the CYP has forgotten to take basal insulin in the evening before the procedure, then administer 50% of the basal insulin dose in the morning. In this situation the evening basal insulin on the day of procedure would also need to be reduced by 50%.

Morning operation scheduled 08:00 – 09:00

Meal: Nil by mouth (omit breakfast).
Test CBG on getting up, before leaving home and on reaching hospital/ward.
Manage CBG as below in the ward:
If CBG is <5mmol/L and cannula in place, give 2ml/kg of 10% glucose over 5 minutes
If CBG <5mmol/L and no cannula, give 40% Glucose gel (<9 years (or <25kg) ½ tube and >=9years (or >25 kg) 1 tube).
If CBG >13.9mmol/L, give rapid acting insulin as per ISF above.
Insulin: Withhold usual morning dose of rapid acting insulin. Administer the usual morning dose of basal insulin if taken twice daily.
Fluids: The decision will be taken by anaesthetist depending on procedure.

Afternoon operation scheduled 13:00 – 14:00

Meal: Allow breakfast but omit lunch.
Test CBG on getting up, 2 hours after breakfast, before leaving home, then hourly.
Manage CBG as below in the ward:
If CBG is <5mmol/L and cannula in place, give 2ml/kg of 10% glucose over 5 minutes
If CBG <5mmol/L and no cannula, give 40% Glucose gel (<9 years (or <25kg) ½ tube and >=9years (or >25 kg) 1 tube).
If CBG >13.9mmol/L, give rapid acting insulin as per ISF above

Insulin: Give 100% of the usual morning dose of rapid acting insulin with breakfast and omit lunchtime dose.

Management in Theatre and in Recovery Room

CBG Monitoring: Test CBG at least hourly, target range (5 – 10mmol/L), intervention range (<5 or >13.9mmol/L).
IV Fluids: Maintenance fluid with 5% glucose in 0.9% saline with 10mmol KCL in 500mls bag may be required if there is a trend towards a low CBG otherwise fluid should be administered according to the anaesthetist's normal practice.
If on glucose containing I.V fluids start Variable Rate Intravenous Insulin Infusion (VRIII).
If CBG <5mmol/L give 2ml/kg of 10% glucose over 5 minutes and recheck CBG in 15mins. Fluid boluses should be with glucose free fluid such as 0.9% saline/Hartmann's solution as deemed necessary by the anaesthetist.
Any Additional Instructions:

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Management in Ward

Measure CBG hourly and aim to keep it 5 – 10mmol/L. Give fluids as above if there is a trend towards a low CBG till the CYP is well enough to tolerate orally. If hypoglycaemia or CBG > 13.9mmol/L manage as per treatment plan above. The meal dose of rapid acting insulin is given as usual once the child is able to eat and drink and stop I.V fluids. **DISCONTINUE INSULIN INFUSION 30 MINUTES AFTER THE DOSE OF RAPID ACTING S/C INSULIN**. If the child is fully recovered consider discharge.

7.2 INDIVIDUALISED PERI-OPERATIVE CARE PLAN – ONE MISSED MEAL MANAGEMENT OF TWICE OR THREE TIMES DAILY MIXED INSULIN REGIMES

Usual type of insulin: **Mixed insulin:** **Rapid acting insulin:**	CBG	Insulin dose Max 2hrly Unless using Smart meter/App	Addressograph
	13.9 mmol/L to _____ mmol/L	Units	**Surname:**
Management of high blood glucose levels. **ISF:** 1 unit of rapid acting insulin will lower CBG by _____ mmol/L. Or use Pump,SMART meter or App.	_____ mmol/L to _____ mmol/L	Units	**First Name:** **DOB:**
	_____ mmol/L to _____ mmol/L	Units	**Hosp No:** **NHS No:**
Form filled in by:	mmol/L to		

The Night before Surgery

Administer usual doses of insulin in the evening; test CBG at bed time.

On the Day of Surgery

Morning operation scheduled 08:00 – 09:00

Meal: Nil by mouth (omit breakfast).
Test CBG on getting up, before leaving home and on reaching hospital/ward.
Manage CBG as below in the ward:
If CBG is <5mmol/L and cannula in place, give 2ml/kg of 10% glucose over 5 minutes
If CBG <5mmol/L and no cannula, give 40% Glucose gel <9 years (or <25kg) ½ tube and >9years (or >25 kg) 1 tube).
If CBG >13.9mmol/L, give rapid acting insulin as per ISF above.
Insulin: Delay morning dose of insulin, give normal dose after the procedure with late breakfast
Fluids: the decision will be taken by anaesthetist depending on procedure.

Afternoon operation scheduled 13:00 – 14:00

Meal: Allow breakfast but omit lunch.
Test CBG on getting up, 2 hours after breakfast, before leaving home, then hourly.
Manage CBG as below in the ward:
If CBG is <5mmol/L and cannula in place, give 2ml/kg of 10% glucose over 5 minutes
If CBG <5mmol/L and no cannula, give 40% Glucose gel <9 years (or <25kg) ½ tube and >9years (or >25 kg) 1 tube).
If CBG >13.9mmol/L, give rapid acting insulin as per ISF
Above Insulin: Give 50% of the usual morning dose of mixed (biphasic) insulin S/C and omit lunchtime mixed (biphasic) insulin dose if usually taken
Fluids: the decision will be taken by anaesthetist depending on procedure.

Management in Theatre and in Recovery Room

CBG Monitoring: Test CBG at least hourly, target range (5 – 10mmol/L), intervention range (<5 or >13.9mmol/L).
IV Fluids: Maintenance fluid with 5% glucose in 0.9% saline with 10mmol KCL in 500mls bag may be required if there is a trend towards a low CBG otherwise fluid should be administered according to the anaesthetist's normal practice.
If on glucose containing I.V fluids start Variable Rate Intravenous Insulin Infusion (VRIII).
If CBG <5mmol/L give 2ml/kg of 10% glucose over 5 minutes and recheck CBG in 15mins. Fluid boluses should be with glucose free fluid such as 0.9% saline/Hartmann's solution as deemed necessary by the anaesthetist.
Any Additional Instructions:

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Management in Ward

Measure CBG hourly and aim to keep it 5–10 mmol/L. Give fluids as above if there is a trend towards a low CBG till the CYP is well enough to tolerate orally. If hypoglycaemia or CBG>13.9 mmol/L manage as per treatment plan above. The evening dose of insulin is given as usual once the CYP has tolerated evening meal. If the child is fully recovered consider discharge.

7.3 INDIVIDUALISED PERI-OPERATIVE CARE PLAN – MANAGEMENT OF INSULIN PUMP THERAPY

Usual type of rapid acting insulin used in pump:	CBG	Insulin dose Max 2hrly Unless	Addressograph
On the Day of Surgery Secure the insulin infusion site to prevent dislodgement. If the surgical / anaesthetic team not comfortable using insulin pumps then follow VRII (appendix 1)			
Management of high blood glucose levels. **ISF:** 1 unit of rapid acting insulin will lower CBG by _____ mmol/L. Or use Pump, SMART meter or App.	_____ mmol/L to _____ mmol/L	Units	**First Name:** **DOB:** **Hosp No:** **NHS No:**
	_____ mmol/L to _____ mmol/L	Units	
Form filled in by:	_____ mmol/L to _____ mmol/L	Units	
Procedure:			

The Night before Surgery
Diabetes team to give and discuss appendix 5 of the guideline with parents.

Morning operation scheduled 08:00 – 09:00

Meal: Nil by mouth (omit breakfast).
Test CBG on getting up, before leaving home and on reaching hospital/ward.
Manage CBG as below in the ward:
If CBG is <5mmol/L and cannula in place, give 2ml/kg of 10% glucose over 5 minutes
If CBG <5mmol/L and no cannula, give 40% Glucose gel <9 years (or <25kg) ½ tube and >9years (or >25 kg) 1 tube).
If CBG >13.9mmol/L, give rapid acting insulin as per ISF above.
Insulin: Continue S/C insulin delivery via insulin pump at the usual basal rates.
Fluids: the decision will be taken by anaesthetist depending on procedure.

Afternoon operation scheduled 13:00 – 14:00

Meal: Allow breakfast with 100% insulin bolus, but omit lunch.
Test CBG on getting up, 2 hours after breakfast, before leaving home, then hourly.
Manage CBG as below in the ward:
If CBG is <5mmol/L and cannula in place, give 2ml/kg of 10% glucose over 5 minutes
If CBG <5mmol/L and no cannula, give 40% Glucose gel <9 years (or <25kg) ½ tube and >9years (or >25 kg) 1 tube).
If CBG >13.9mmol/L, give rapid acting insulin as per ISF above.
Insulin: Continue S/C insulin delivery via insulin pump at the usual basal rates.
Fluids: the decision will be taken by anaesthetist depending on procedure.

Management in Theatre and in Recovery Room

CBG Monitoring: Test CBG at least hourly, target range (5 – 10mmol/L), intervention range (<5 or >13.9mmol/L).
IV Fluids: Maintenance fluid with 5% glucose in 0.9% saline with 10mmol KCL in 500mls bag may be required if there is a trend towards a low CBG otherwise fluid should be administered according to the anaesthetist's normal practice.
If on glucose containing I.V fluids start Variable Rate Intravenous Insulin Infusion (VRIII) & discontinue pump therapy.
If CBG <5mmol/L give 2ml/kg of 10% glucose over 5 minutes and recheck CBG in 15 mins. Fluid boluses should be with glucose free fluid such as 0.9%saline/Hartmann's solution as deemed necessary by the anaesthetist.
Any Additional Instructions:

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Management in Ward

Measure CBG hourly and aim to keep it 5 – 10mmol/L. Maintenance fluid with 5% glucose in 0.9% saline with 10mmol KCL in 500mls bag may be required if there is a trend towards a low CBG till the CYP is well enough to tolerate orally. If on glucose containing I.V fluids start VRIII. If hypoglycaemia or CBG > 13.9mmol/L manage as per treatment plan above. The meal dose of rapid acting insulin is given as usual once the child is able to eat and drink and stop I.V fluids. **STOP I.V INSULIN 60 MINUTES AFTER STARTING S/C INSULIN VIA PUMP**. If the child is fully recovered consider discharge.

7.4 INDIVIDUALISED PERI-OPERATIVE CARE PLAN – ONE MISSED MEAL MANAGEMENT OF TYPE 2 DIABETES

Usual type of rapid acting insulin: **Basal:** **Bolus:**	CBG	Insulin dose Max 2hrly Unless using Smart meter/App	Addressograph
	13.9 mmol/L to _____ mmol/L	Units	**Surname:**
Management of high blood glucose levels. **ISF:** 1 unit of rapid acting insulin will lower CBG by _____ mmol/L. Or use SMART meter or App.	_____ mmol/L to _____ mmol/L	Units	**First Name:** **DOB:**
	_____ mmol/L to _____ mmol/L	Units	**Hosp No:**
Form filled in by:	_____ mmol/L to _____ mmol/L	Units	**NHS No:**
Procedure:			

The Night before Surgery

If young person is on metformin stop 24 hours before the procedure

If young person is on other non-insulin diabetic treatment please refer to appendix 10

On the Day of Surgery

For more than one missed meal use VRII (appendix 1)

CYP on insulin and/or oral drugs

Meal: Nil by mouth (omit breakfast).
Test CBG on getting up, before leaving home and on reaching hospital/ward.
Manage CBG as below in the ward:
If CBG is <5mmol/L and cannula in place, give 2ml/kg of 10% glucose over 5 minutes
If CBG <5mmol/L and no cannula, give 40% Glucose gel <9 years (or <25kg) ½ tube and >9years (or >25 kg) 1 tube).
If CBG >13.9mmol/L, give rapid acting insulin as per ISF above
Fluids: the decision will be taken by anaesthetist depending on procedure.

CYP on oral drugs only

Meal: Nil by mouth (omit breakfast).
Test CBG on getting up, 2 hour after breakfast, before leaving home, then hourly.
Manage CBG as below in the ward:
If CBG >12mmol/L, check for Blood ketones.
Give 0.1 U/kg of rapid acting insulin.
Consider the need to use variable rate intravenous insulin infusion (VRIII).
Caution: If young person is on Metformin and less than 24 hours since the last dose for emergency surgery, it is essential to maintain hydration with IV fluids before and after surgery.
Fluids: the decision will be taken by anaesthetist depending on procedure.

Management in Theatre and in Recovery Room

CBG Monitoring: Test CBG at least hourly, target range (5 – 10mmol/L), intervention range (<5 or >13.9mmol/L).
IV Fluids: Maintenance fluid with 5% glucose in 0.9% saline with 10mmol KCL in 500mls bag may be required if there is a trend towards a low CBG otherwise fluid should be administered according to the anaesthetist's normal practice.
If on glucose containing I.V fluids start Variable rate intravenous insulin infusion (VRIII).
If CBG <5mmol/L consider giving 2 ml/kg of 10% glucose over 5 minutes and recheck CBG in 15 mins. Fluid boluses should be with glucose free fluid such as 0.9% saline/Hartmann's solution as deemed necessary by the anaesthetist.
Any Additional Instructions:

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Management in Ward

Measure CBG hourly and aim to keep it 5 – 10mmol/L. Maintenance fluid with 5% glucose in 0.9% saline with 10mmol KCL in 500mls bag may be required if there is a trend towards a low CBG till the CYP is well enough to tolerate orally. If on glucose containing I.V fluids start VRIII. If hypoglycaemia or CBG > 13.9mmol/L manage as per treatment plan above. If on S/C insulin, the meal dose of rapid acting insulin is given as usual once the child is able to eat and drink and stop I.V fluids. **DISCONTINUE INSULIN INFUSION 30 MINUTES AFTER THE DOSE OF RAPID ACTING S/C INSULIN**. If the child is fully recovered consider discharge.

Re-starting oral medication for Type 2 diabetes:

- If on metformin recommence 48hrs after surgery/procedure and if eGFR /renal function is normal
- If on other non-insulin diabetic treatment please check appendix 10

7.5 INDIVIDUALISED CARE PLAN – ONE MISSED MEAL MANAGEMENT OF CYSTIC FIBROSIS RELATED DIABETES (CFRD)

<table>
<tr><td rowspan="2">Usual type of rapid acting insulin:
Basal:
Bolus:</td><td>CBG</td><td>Insulin dose Max 2hrly Unless using Smart meter/App</td><td>Addressograph</td></tr>
<tr><td>13.9 mmol/L to _____ mmol/L</td><td>Units</td><td rowspan="4">Surname:
First Name:
DOB:
Hosp No:
NHS No:</td></tr>
<tr><td rowspan="2">Management of high blood glucose levels.
ISF: 1 unit of rapid acting insulin will lower CBG by _____ mmol/L. Or use SMART meter or App.</td><td>_____ mmol/L to _____ mmol/L</td><td>Units</td></tr>
<tr><td>_____ mmol/L to _____ mmol/L</td><td>Units</td></tr>
<tr><td>Form filled in by:</td><td>_____ mmol/L to _____ mmol/L</td><td>Units</td></tr>
<tr><td colspan="4">Procedure:</td></tr>
</table>

The Night before Surgery

First determine the insulin regimen (appendix 6) of the patient and advise accordingly as below (delete as appropriate)

- If CYP is on once daily evening basal insulin give half the dose in the evening before surgery.
- If CYP is on once daily morning basal insulin give the usual dose the day before surgery.
- If the CYP also takes rapid acting insulin with meals continue the usual dose the day before surgery.
- If CYP is on twice daily ''Mixed Insulin'', take usual dose the night before surgery.

On the Day of Surgery

For more than one missed meal use VRII (Appendix 1)

Test CBG on getting up, before leaving home and on reaching hospital/ward.

Meal: Nil by mouth (miss the meal before surgery).

Insulin: For insulin adjustment see Appendix 6, write a plan here:

_____

_____

_____

Manage CBG as below in the ward:

- If CBG is <5mmol/L and cannula in place, give 2ml/kg of 10% glucose over 5 minutes.
- If CBG <5mmol/L and no cannula, give 40% Glucose gel <9years (or <25kg) ½ tube and >9years (or >25 kg) 1 tube
- If CBG >13.9mmol/L, give rapid acting insulin as per ISF above

Fluids: the decision will be taken by anaesthetist depending on procedure

Management in Theatre and in Recovery Room

CBG Monitoring: Test CBG at least hourly, target range (5 – 10mmol/L), intervention range (< 5 or > 13.9 mmol/L).

IV Fluids: Maintenance fluid with 5% dextrose in 0.9 % saline may be required if there is a trend towards a low CBG otherwise fluid should be administered according to the anaesthetist's normal practice. If CBG < 5mmol/L consider giving 2ml/kg of 10% dextrose over 5 minutes. Fluid boluses should be with glucose free fluid such as 0.9%saline/Hartmann's solution as deemed necessary by the anaesthetist.

Any Additional Instructions:

_____

_____

_____

Management in Ward

Measure CBG hourly and aim to keep it 5 – 10mmol/L. Consider fluids as above if there is a trend towards a low CBG till the CYP is well enough to tolerate orally. If on glucose containing I.V fluids start VRIII. If hypoglycaemia or CBG > 13.9mmol/L manage as per treatment plan above .The meal dose of rapid acting insulin is given as usual once the child is able to eat and drink and stop I.V fluids. **DISCONTINUE INSULIN INFUSION 30 MINUTES AFTER THE DOSE OF RAPID ACTING S/C INSULIN**. If the child is fully recovered consider discharge.

7.6 Management of surgery requiring more than one missed meal
Variable Rate Intravenous Insulin Infusion (VRIII)

Procedure: **Usual insulin dose:** **Basal:** **Bolus:**	**Surname:** **First Name:** **DOB:** **Hosp No:** **NHS No:**

The Night before Surgery

Administer usual doses of insulin; (write the name and dose of insulin using appendix 6):

_____

_____

On the Day of Surgery

For planned surgery nil by mouth, omit breakfast and **DO NOT GIVE** bolus (rapid acting) insulin in the morning. Can have the morning basal insulin . For emergency surgery see page 7(Section 5.7) of the guideline.

Administer insulin infusion and maintenance fluids on the morning of procedure

Add soluble insulin 50 units to 49.5ml sodium chloride 0.9%, making a solution of 1 unit insulin/ml

Caution: only use insulin syringe to measure and prepare insulin for an intravenous infusion.

For safer administration of VRIII follow instructions on appendix 1.

Infusion rate is adjusted according to CBG.

Variable rate Intravenous Insulin Infusion rate	CBG (mmol/L)
0.025 ml/kg/hr (i.e. 0.025 Units/kg/hr)	5 - 7.9
0.05 ml/kg/hr (i.e. 0.05 Units/kg/hr)	8 – 11.9
0.075 ml/kg/hr (i.e. 0.075 Units/kg/hr)	12 – 14.9
0.1 ml/kg/hr (i.e. 0.1Units/kg/hr)	>= 15

Monitor CBG half hourly: The aim of the VRIII is to maintain CBG 5-10 mmol/L. If CBG is <5mmol/L give 2ml/kg of 10% glucose over 5 minutes. Retest CBG after 15 minutes to ensure that the level of blood glucose is >5 mmol/L, otherwise repeat 10% glucose bolus as above. If CBG is < 5 mmol/L, insulin infusion can be temporarily stopped for 10 to 15 minutes. Restart VRIII once CBG >5 mmol/L.

Parenteral maintenance fluids: The standard intravenous fluid to run alongside the VRIII is 5% glucose in 0.9% saline with 10 mmol in a 500ml bag (appendix 9). Monitor electrolytes daily to avoid hyponatraemia. If CBG rises >14mmol/L, change to 0.9% sodium chloride with 10mmol KCl in 500ml bag.

Any Additional Instructions:

_____

Management in Recovery Room

Continue to monitor CBG half to one hourly.

Continue parenteral maintenance fluids as above.

Management in Ward

Measure CBG hourly and continue parenteral maintenance fluids as above. Once CYP able to tolerate oral food give S/C insulin with meal. Discontinue insulin infusion 30 minutes after the subcutaneous dose of rapid acting insulin (appendix 6). **DISCONTINUE INSULIN INFUSION 30 MINUTES AFTER THE DOSE OF RAPID ACTING S/C INSULIN and 60 MINUTES AFTER RECOMMENCING INSULIN PUMP THERAPY** (appendix 6). The meal dose of rapid acting insulin is given as usual once the child is able to eat and drink. If the child is fully recovered consider discharge.

7.7 INDIVIDUALISED CARE PLAN – MANAGEMENT OF PROCEDURES NOT REQUIRING MISSED MEAL

Endoscopy / bronchoscopy / biopsy / insertion of long line / joint injection / lumbar puncture / dental extraction etc.

<table>
<tr><td rowspan="2">Usual type of rapid acting insulin:
Basal:
Bolus:</td><td>CBG</td><td>Insulin dose Max 2hrly Unless using Smart meter/App</td><td>Addressograph</td></tr>
<tr><td>14 mmol/L to _____ mmol/L</td><td>Units</td><td rowspan="4">Surname:
First Name:
DOB:
Hosp No:
NHS No:</td></tr>
<tr><td rowspan="3">Management of high blood glucose levels.
ISF: 1 unit of rapid acting insulin will lower CBG by _____ mmol/L. Or use SMART meter or App.</td><td>_____ mmol/L to _____ mmol/L</td><td>Units</td></tr>
<tr><td>_____ mmol/L to _____ mmol/L</td><td>Units</td></tr>
<tr><td>Form filled in by:</td><td>_____ mmol/L to _____ mmol/L</td><td>Units</td></tr>
<tr><td colspan="4">Procedure:</td></tr>
</table>

Pre-procedure Instructions

- Patient should follow the pre-procedure instruction provided by the team carrying out the procedure.
- Overnight admission may be required for younger patients or those with difficulties in maintaining adequate fluid intake during e.g. bowel preparation or bowel preparation requiring more than one missed meal. In these cases use (VRIII), (appendix 1).

Pre-procedure Adjustment of insulin (delete as appropriate)

For CYP on insulin injections (appendix 6) or for CYP on insulin pump therapy appendix 5. Write a plan here:

_____

_____

On the Day of Procedure

For insulin adjustment see (appendix 6), write a plan here:

_____

_____

_____

- Continue CBG monitoring hourly before and after the procedure.
- Maintain CBG levels 5-10mmol/L, intervention range <5 or >13.9mmol/L.
- If CBG is <5mmol/L and cannula in place, give 2.0ml/kg of 10% glucose over 5 minutes
- If CBG <5mmol/L and no cannula, give 40% Glucose gel (<9 years (or <25kg) ½ tube and >9years (or >25 kg) 1 tube).
- If CBG >13.9mmol/L, give rapid acting insulin as per ISF
- Infuse 5% dextrose in 0.9% saline with 10 mmol KCL at maintenance rate if the child is not tolerating oral fluids.

After the procedure, aim to keep CBG 5-10 mmol/L.

If CBG > 13.9mmol/L: For CYP on insulin injections: Give rapid-acting insulin subcutaneously (maximum 2 hourly or as advised by SMART meter/App) to correct capillary blood glucose >13.9 mmol/L using insulin sensitivity factor as above. For CYP on insulin pump: Re-connect insulin pump & give correction bolus using pump's bolus calculator (delete as appropriate).

If CBG < 5mmol/L and not tolerating orally give 2.0ml/kg of 10% glucose over 5 minutes, otherwise offer Glucose gel 40% (<9 years (or <25kg) ½ tube and >9years (or >25 kg) 1 tube).

Appendix 1:

Safer Administration of Variable Rate Intravenous Insulin Infusion (VRIII)

VRIII

It is accepted that the use of a VRIII is a complicated procedure and errors during preparation and administration could be lethal. Care and accuracy when preparing an insulin infusion is, therefore, paramount. For safer administration of insulin see recommendations on page 7. The purpose of this section of the guideline is to clearly set out the procedures to ensure safe use of VRIII.

Aim:

The aim of the VRIII is to maintain the blood glucose level 5-10mmol/L. It is important that patients with diabetes have a constant level of insulin to prevent ketosis.

Indications:

VRIII is indicated for surgery requiring a starvation period more than one missed meal, emergency surgery in an ill child. If in DKA use BSPED DKA guideline[8] (failure to do this is a critical incident). The child/young person can continue on their Basal insulin while on variable rate insulin infusion.

Principles:

- When an intravenous insulin infusion is used, fluids containing dextrose (appendix 9) should be infused continuously until the patient is eating and drinking.
- There is evidence that the risk of acute hyponatremia may be increased when using hypotonic parental maintenance fluid[10,11,12] (i.e. <0.9% saline) in hospitalised children.
- The standard intravenous fluid to run alongside the VRIII is 5% dextrose in 0.9% saline with 10mmol/500ml KCl[1,15] (appendix 9).
- The initial insulin infusion rate is determined by the CBG (VRIII) and adjusted based on blood glucose level as below.
- The CBG should be monitored at least hourly.
- The rate of fluid must be set to deliver the hourly fluid requirements.

Preparation of VRIII:

- An insulin syringe **MUST** be used to measure and prepare insulin for an intravenous infusion. Add soluble insulin (Actrapid®) 50 units to 49.5ml sodium chloride 0.9%, making a solution of 1 unit insulin/ml.
- Delivery of the dextrose solution and the VRIII must be via a single cannula with appropriate one- way and anti-siphon double lumen valve.

50 ml luer-lock Syringe | Insulin Syringe | 50ml Syringe

49.5ml Sodium Chloride 0.9% + 50 Units Actrapid Insulin = Final volume 50ml (1 unit of insulin / ml)

Variable rate Intravenous Insulin Infusion rate	CBG (mmol/L)
0.025 ml/kg/hr (i.e. 0.025 Units/kg/hr)	5 - 7.9
0.05 ml/kg/hr (i.e. 0.05 Units/kg/hr)	8 – 11.9
0.075 ml/kg/hr (i.e. 0.075 Units/kg/hr)	12 – 14.9
0.1 ml/kg/hr (i.e. 0.1Units/kg/hr)	>= 15

Monitor CBG at least hourly: The aim of the VRIII is to maintain CBG 5-10 mmol/L. If CBG is < 5mmol/L give 2ml/kg of 10% glucose over 5 minutes. Recheck CBG after 15 minutes to ensure that the level of blood glucose is >5 mmol/L, otherwise repeat 10% glucose bolus as above. If CBG is < 5 mmol/L, insulin infusion can be temporarily stopped for 10 to 15 minutes. Restart VRIII once CBG >5 mmol/L.

Transferring from VRIII to subcutaneous insulin:

- Restart the normal pre-surgical regimen. Be prepared to adjust the doses because the insulin requirement may change as a result of the surgery/procedure.
- Once the patient is able to tolerate food orally give S/C insulin. **DISCONTINUE INSULIN INFUSION 30 MINUTES AFTER THE DOSE OF RAPID ACTING S/C INSULIN AND 60 MINUTES AFTER RECOMMENCING INSULIN PUMP THERAPY** (appendix 6).
- Consult the diabetes team if the CBG is outside the acceptable range (5-10mmol/L).

Appendix 2:

Planning
Careful planning and good communication is essential for successful surgery and outcome.

- Surgeon/Physician/Anaesthetist/pre-operative nurse communicates with the diabetes team as soon as the decision is made to undertake the surgery/procedure
- Surgeon/Physician/ Anaesthetist/ pre-operative nurse fills in the pre-operative information sheet (appendix 3) and sends it to the patient's diabetes team (please add own diabetes team's contact details)

- The diabetes team assesses pre-operative diabetes control and helps CYP to improve diabetes control before surgery/procedure.
- Diabetes team selects and completes the appropriate individualised care plan (ICP) according to the CYP insulin regimen **(page 2)** and the pre-operative information provided by the surgeon/physician. The individualised care plan also depends on the type of procedure and whether patient would require missed meal (one or more than one) or not **(page 2).**
- The diabetes team files the ICP in the CYP hospital notes.
- Diabetes team gives and explains appropriate information leaflet regarding pre-operative adjustment of insulin (appendix 4 or 5) to CYP/patient. 'Quick Guide' regarding adjustment of insulin before surgery is also provided in appendix 6.
- Diabetes team should instruct parents to bring their own insulin to hospital so that the CYP can be restarted on their usual insulin as soon as possible.
- Diabetes team also instruct CYP/parents to bring their blood glucose monitoring equipment and hypoglycaemia treatment.

- The ICP to be used by anaesthetist, paediatricians, physicians, surgeons and nurses to guide diabetes management pre-, intra- and post-operatively.
- Diabetes team to be contacted for advice during the perioperative period (please add contact details of local diabetes team here)
- Surgical team discusses with anaesthetist to schedule surgery as 'FIRST CASE' on a surgical list.
- The Ward/Acute Area nurse responsible for the care of the child goes through the suggested check list before surgery (appendix 7) and files the individualised care plan in the front of the notes.
- Anaesthetist follows the individualised care plan in the theatre and during recovery.

- Ward acute area nurse continues to follow individualised care plan on CYP's return to the ward.
- The CYP can be discharged once able to tolerate food orally and the observations are stable for at least 4 hours after the procedure.
- CYP can be discharged if CBG falls between 5 and 14mmol/L.
- If CBG is more than 13.9mmol/L give rapid acting insulin as per insulin sensitivity factor **(page 8).** If on insulin pump give correction bolus using pump bolus calculator. Repeat CBG after 2 hours. If it is still above13.9mmol/L, check blood ketones and correct elevated blood glucose with rapid acting insulin. The CYP should be monitored carefully for the risk of developing diabetic ketoacidosis (DKA) and inform diabetes team.
- Make sure CBG > 5mmol/L.
- Ward / Acute Area nurse provides appendix 8 (advice for CYP with diabetes who are discharged following surgical procedure) to patients/parents.
- Ward/Acute Area nurse to inform the diabetes team regarding discharge.

Appendix 3:

Pre-operative Notification Form: For children over 6 months and < 18yrs under the care of Paediatric diabetes team and admitted to hospital for surgery and procedures in the Ward/Acute Areas.

To be completed by the surgeon/physician with knowledge of the procedure to be undertaken	**For staff use only:** **Surname:** **First Name:** **DOB:** **Hosp No:** **(use hospital identification label)**

Name of the procedure: ……..

Is CYP required to fast longer than usual pre-op, 6hrs for food or milk & 2hrs for clear fluid (water or squash):
YES/NO

If **YES**, please give details of pre-op fasting instructions:

_____

_____

Expected duration of peri-operative starvation (please tick the appropriate box):

- **Anticipated short starvation period requiring one missed meal:**
  The planned starvation period (includes the total of pre-anaesthetic and post-anaesthetic missed meals) is short and generally less than 12 hours. In practice this means that CYP should be first on a morning or an afternoon list, and able to resume a normal oral intake after the procedure/surgery, so that they only miss either breakfast or lunch. ☐
- **Anticipated starvation period requiring more than one missed meal:**
  The peri-operative starvation period is likely to involve more than one missed meal, e.g., breakfast and lunch, or a period of pre-operative diet change to facilitate bowel prep or delay in resumption of normal intake post-operatively. ☐
- **Anticipated starvation period not requiring a missed meal (delayed meal):**
  CYP requiring anaesthesia/sedation for a maximum of 30 minutes and rapid recovery is anticipated (ideally early morning cases). ☐
- **Is bowel prep required: YES / NO**

- **Is a low residue food diet required pre-op: YES / NO**
- **Expected duration of procedure: _____hours _____ minutes.**
- **Is child expected to resume normal oral intake immediately post-op: YES / NO**

If **NO**, please give details of expected delays or restrictions (e.g. clear fluids for 4hr).

_____
_____
_____

Consultant Surgeon/Physician in charge of admission: _____

Consultant Anaesthetist doing the anaesthesia for the procedure: _____

Consultant Paediatrician specialised in Diabetes: _____

Key worker (Paediatric Diabetes Specialist Nurse) _____

Form filled in by (Name): _____

Signature: _____

Date: _____

Please send this form to the CYP diabetes team by post or email and file one copy in CYP's hospital notes.

Appendix 4:

Pre-operative advice for Child/Young Person with type 1 diabetes on multiple daily insulin injections

Diabetes team should provide and explain this sheet to the parents/CYP

(For procedures requiring one missed meal) The day before surgery/procedure

Administer usual dose of insulin.

- Reduce the preceding evening's basal insulin only up to 20% if there is a pattern of low capillary blood glucose values in the preceding 3-4 mornings. Otherwise continue your basal insulin as normal.
- Check your blood glucose before bed time and take appropriate action; if in doubt contact your diabetes team or out of hours diabetes advice service.
- Follow the advice provided by the surgical team regarding nil by mouth.

On the day of surgery/procedure

- Check your blood glucose before leaving home. If the glucose level is less than 4mmol/L take glucose gel 40% 10 to 20 grams by mouth and check the glucose level again in 15 minutes.
- If the surgery is in the **morning** then omit breakfast and do not give any rapid acting insulin.

- If you take basal insulin in the morning (Lantus®/Glargine or Levemir®/ Detemir or Tresiba®/Degludec) and the surgery is also planned in the **morning** then omit breakfast and give the usual dose of basal insulin at the usual time,
- If the surgery is in the **afternoon** then you may be allowed to take light breakfast. Take an appropriate dose of rapid acting insulin (Humalog® or NovoRapid® or Apidra® or Fiasp®)
- On admission your blood glucose will be checked again.
- You may need intravenous fluids with glucose to prevent hypoglycaemia.

Please bring your own insulin to hospital. This is important.

If you have any questions regarding this advice, please ask your diabetes team for further information

Tel: ADD TEAM CONTACT NUMBER HERE

Email: ADD TEAM CONTACT EMAIL HERE

Appendix 5:

Pre-operative advice for Children/Young people on insulin pump therapy

Diabetes team should provide and explain this sheet to the parents/child

The day before surgery/procedure

- Administer the usual dose of insulin and continue with the same basal rates.
- Consider reducing the night time basal rates by 20% (set up temporary basal rates) only if there is a pattern of low blood glucose in the preceding 3 to 4 mornings.
- Change the reservoir, cannula and infusion set in the afternoon before surgery, but no later than tea time.
- Bring additional pump supplies with you to the hospital
- Check capillary blood glucose before bedtime to make sure the new infusion set insertion is working and take appropriate action. If in doubt contact your diabetes team or out of hours diabetes advice service.
- Make sure the battery of the pump is at least half charged.

- Make sure the date and time on the pump is correct.
- Check all the pump settings (basal rates, carbohydrate ratios, target blood glucose, insulin active time/insulin on board and insulin sensitivity factor).

Your anaesthetist may decide it appropriate to discontinue the pump therapy prior to surgery. They will explain this to you on the day if necessary along with alternative treatment options. Please ask your diabetes team for further information or discuss this with the anaesthetist during the pre-operative assessment visit.

Tel: ADD TEAM CONTACT NUMBER HERE

Email: ADD TEAM CONTACT EMAIL HERE

Appendix 6:

Commonly used insulins/insulin regimes and Adjustment of insulin before surgery – ''Quick guide''

Insulin regimen	Day before procedure	Day of surgery	
		Morning list	**Afternoon list**
Once daily (evening) Basal insulin Glargine (Lantus) Detemir (Levemir) Degludec (Tresiba)	Continue usual dose	Continue usual dose. Consider reducing dose up to 20% if there is a pattern of low CBG in the morning.	Continue usual dose
Once daily (morning) Basal insulin Glargine (Lantus) Detemir (Levemir) Degludec (Tresiba)	Continue usual dose	Check that the usual dose has been taken in the morning. Check CBG at admission. Follow flow sheet for further management.	Check that the usual dose has been taken in the morning Check CBG at admission. Follow flow sheet for further management.
MDI insulin regimen Patients take once daily basal insulin in the morning or in the evening or sometimes split the basal insulin in the morning and evening and rapid acting insulin with each meal. This is also called MDI and involves 4 to 5 injections/day. **Basal insulins analogues:** Insulin Glargine (Lantus) Insulin Detemir (Levemir) Insulin Degludec (Tresiba) **Rapid acting insulins analogues:** Insulin Lispro (Humalog®) Insulin Aspart (NovoRapid®) Insulin Glulisine (Apidra®) Insulin Fiasp **Short acting insulins analogues:** Regular [Soluble] (Actrapid®/or Humulin S®)	Continue usual dose	Withhold usual morning dose of rapid acting insulin. Basal insulin advice as above. *If patient takes basal insulin both in the morning and in the evening consider reducing the morning basal insulin dose.*	Take usual morning rapid acting insulin with breakfast. Omit lunch time dose. Basal insulin as usual. *If patient takes basal insulin both in the morning and in the evening consider reducing the morning basal insulin dose.*
Twice Daily Mixed insulin NovoMix 30®, Humulin M3®, Humalog Mix 25®, Humalog Mix 50® Insuman® Comb 25, Insuman® Comb 50.	Continue usual dose	**When patient arrives in the Ward** Delay morning dose of insulin, give normal dose after the procedure with late breakfast. Take usual insulin dose with evening meal.	**When patient arrives in the ward** Check that 50% of usual dose was given in the morning. Allow child to eat light breakfast. Take usual insulin dose with evening meal.
Insulin pump therapy Novorapid given as continuous sub-cutaneous insulin infusion (CSII)	Continue usual dose	Continue S/C insulin delivery via insulin pump at the usual basal rates (follow advice as per individualised care plan)	Continue S/C insulin delivery via insulin pump at the usual basal rates (follow advice as per individualised care plan)

Appendix 7:

Check list for the Ward/Acute Area nurse responsible for the care of the CYP with diabetes undergoing surgery / procedure

On the day of surgery/procedure

- Check capillary blood glucose at admission.
- Request appropriate team to clerk the CYP.
- Follow instructions on the individualised care plan and attach this on the front of the notes.
- Inform diabetes team regarding admission.
- Make sure hospital identification label is attached on the individualised care plan.
- For a CYP requiring variable intravenous insulin infusion (VRIII),

  Do Not Give morning dose of mixed or rapid acting subcutaneous insulin. VRIII must be commenced within an hour of the missed rapid acting insulin dose. The CYP should continue to have their usual basal insulin.

- Check with CYP if they have brought their own insulin. If not request from pharmacy.
- For safe preparation and administration of intravenous insulin (VRIII) see instructions on appendix 1.
- For CYP on insulin pumps make sure parents/patient has followed the check list provided by the diabetes team appendix 5.
- Make sure Oral glucose gel 40% is available to treat hypoglycaemia (page 6). Advice is provided on the individualised care plan for treatment of hypoglycaemia; alternatively follow trust guidelines for the management of hypoglycaemia in CYP.

Appendix 8:

Advice for CYP with diabetes that are discharged following a surgical procedure

Insulin and blood glucose monitoring

- Continue your insulin and other medication as usual or as advised in the discharge letter.
- You may need to check your blood glucose more frequently especially if you are unwell or being sick.
- Your blood glucose may be higher than usual. This is not a concern if you are feeling well and blood ketones are not raised.
- You may need extra doses of rapid acting insulin to correct blood glucose levels above the target range.

When should I call my diabetes team?

- **Continuous** diarrhoea, vomiting or fever
- **Unable to keep food** down for 4 hours or more
- **High blood glucose** (14mmol/L or above), despite extra rapid acting insulin
- **Blood Ketones** above 1.5mmol/L and rising despite extra insulin
- Contact member of your diabetes team during normal working hours, **Tel:** ADD TEAM CONTACT NUMBER HERE
- Outside normal working hours contact the ''Out of Hours'' diabetes service, **Tel:** ADD TEAM CONTACT NUMBER HERE

Sick day rules (Illness Management)

Follow the sick day (Illness management) rules provided by your diabetes team.

The general principles are:

- **Never** stop taking your insulin,
- **Check** your blood glucose every 2 hours
- **Check** for blood ketone every 2 hours.
- **Drink** water/sugar free fluids every hour
- **Eat** as normally as you can. If you cannot eat or have reduced appetite, replace solid food during illness with sugary fluids or semi solids e.g. milk, ice cream, fruit juice etc.

Appendix 9:

Parenteral Maintenance Fluids (PMF)

Choice of intravenous fluid

- These recommendations are modified from the results of a recently conducted randomised control trial[10], ISPAD clinical practice consensus guidelines[1] and NICE guideline on intravenous fluid therapy in children[15]. Hospital acquired hyponatraemia is common, and children undergoing surgery are at particular risk [10,11,12]. It is recognised that hyponatraemia is associated with severe neurological morbidity.
- The consensus for this guideline is that the standard intravenous fluid to run alongside the VRIII is 5% dextrose in 0.9% saline with 10mmol/500ml KCl[1,15].
- Monitor electrolytes daily to check for hyponatremia.
- If hyponatremia despite using 0.9% saline containing fluid, discuss with the diabetes team.
- The fluid infusion rate is calculated according to body weight using the Holliday-Segar nomogram (100mlg/kg/day for the 1st 10kg body weight, 50ml/kg/day for the 2nd 10kg of weight, 20ml/kg/day for the remaining weight)[15].

Availability of pre-made 5% dextrose in 0.9% saline with 10mmol KCl / 500ml bags

- 5% dextrose in 0.9% saline with 10mmol KCl and without KCl in a 500ml bag is available
- The potassium containing fluid is quite expensive but this outweighs the risk of having to add potassium in some hospital settings. Some units allow addition of potassium in the fluid.
- All units would need to make their own arrangements regarding the availability of these fluids.

Appendix 10

For further details please consult the individual monographs.

Table 1: Management of Non-insulin Diabetic Medication in the Perioperative Period[18] *

For combination products refer to *figure 6* for perioperative medication advice

** If eGFR<60 and contrast media is planned omit metformin on the day of surgery and for 48 hours post-operatively

*** If restricted dietary intake expected see *SGLT-2 inhibitor* monograph for advice

Table 2: Management of combination products containing more than one non-insulin diabetic medication in the Perioperative Period[18]

Combination Products

Consideration should be given to prescribing the individual components separately so that the usual perioperative advice can be followed for each component (as per the individual monographs). This is particularly important for combination products containing SGLT-2 inhibitors which require a longer period of treatment interruption.

If this is not possible ***Table 2*** summarises the perioperative advice for medications containing more than one non-insulin diabetic medication.

Combination Product	Examples	Morning operation	Afternoon operation	Post-operative advice
Metformin+ pioglitazone	Competact®	Continue*		Once eating and drinking normally and VRIII (if used) has been stopped, check eGFR and follow advice in *Metformin* monograph
Metformin+ DPP-IV Inhibitors	Eucreas® Janumet® Jentadueto® Komboglyze® Vipdomet®	Continue*		Once eating and drinking normally and VRIII (if used) has been stopped, check eGFR and follow advice in *Metformin* monograph
Metformin+ SGLT-2 Inhibitors	Synjardy® Vokanamet® Xigduo®	Omit dose on **day before** AND day of operation**		Only restart once eating and drinking normally, any volume depletion has been corrected, ketone levels are normal, patient is medically stable and VRIII (if used) has been stopped

SGLT-2 Inhibitors + DPP-IV Inhibitors	Glyxambi® Qtern®	Omit dose on **day before** AND day of operation**	Only restart once eating and drinking normally, any volume **depletion has been** corrected, ketone levels are normal, patient is medically stable and VRIII (if used) has been stopped

* If eGFR<60 and contrast media is planned omit metformin on the day of surgery and for 48 hours post-operatively

** If restricted dietary intake expected see *SGLT-2 Inhibitor* monograph for advice

Reference

Centre for Perioperative Care. Guideline for Perioperative Care for People with Diabetes Mellitus Undergoing Elective and Emergency Surgery (March 2021). Figure 5(Table 1) and Figure 6(Table 2): Available at: https://www.ukcpa-periophandbook.co.uk/medicine-monographs/diabetes-a-summary
Detailed guideline : https://www.cpoc.org.uk/sites/cpoc/files/documents/2021-05/CPOC-Diabetes-Guideline2021.pdf [accessed 19th Oct 2021]

References:

1. Jefferies C et al. ISPAD clinical practice consensus guidelines 2018: Management of children and adolescents with diabetes requiring surgery. Pediatric Diabetes. 2018 Oct 1;19(Suppl 27):227-36

2. Rhodes ET et al. Management of children and adolescents with diabetes requiring surgery. Pediatric diabetes. 2014 Sep;15(S20): 224-31

3. Management of adults with diabetes undergoing surgery and elective procedures: improving standards, March 2016 [https://www.diabetes.org.uk/resources-s3/2017-09/Surgical guidelines 2015%20 %20full%20FINAL%20amended%20Mar %202016_0.pdf]

4. Rhodes ET et al. Perioperative management of Pediatric surgical patients with diabetes mellitus. Anesth Analg, 2005; 101: 986-99

5. Golden SH et al. Perioperative glycemic control and the risk of infectious complications in a cohort of adults with diabetes. Diabetes Care, 1999; 221: 1408-14

6. Van Den Berghe G, et al. Intensive insulin therapy in the critically ill patients. NEJM, 2001; 345: 1359-67

7. Kaufman FR et al. Perioperative management with prolonged intravenous insulin infusion versus subcutaneous insulin in children with type 1 diabetes mellitus. J Diabetes Complications, 1996; 10/1: 6-11

8. BSPED Interim Guideline for the Management of Children and Young People under the age of 18 years with Diabetic Ketoacidosis accessible: https://www.bsped.org.uk/media/1798/bsped-dka-guideline-2020.pdf

9. National Patient Safety Agency. Rapid response report. Safer use of insulin. NPSA/2010/RRR013 http://www.nrls.npsa.nhs.uk/resources/type/alerts/?entryid45=74287

10. Choong K, et al. Hypotonic versus isotonic maintenance fluids after surgery for children: a randomised controlled trial. Pediatrics, 2011; 128: 857-66

11. Dearlove OR et al. Hyponatremia after postoperative fluid management in children. Br J Anaesth, 2006; 97: 897-98

12. Au Ak et al. Incidence of postoperative hyponatremia and complications in critically-ill children treated with hypotonic and normotonic solutions. J Pediatr, 2008; 152: 33-38

13. Holliday M et al. Fluid therapy for children: facts, fashions and questions. Arch Dis Child, 2007; 92: 546-550

14. Care of children under 18 years with Diabetes Mellitus undergoing Surgery ACDC version 3 Aug 2017; accessible : http://www.a-c-d-c.org/wp-content/uploads/2012/08/Care-of-children-under-18-years-with-Diabetes-Mellitus-undergoing-Surgery-1.pdf

15. Intravenous fluid therapy in children and young people in hospital, NICE guideline [NG29] Published date: December 2015 (last updated: June 2020) https://www.nice.org.uk/guidance

16. Diabetes (type 1 and type 2) in children and young people: diagnosis and management, NICE guideline [NG18] Published date: 01 August 2015, (Last updated: 16 December 2020) https://www.nice.org.uk/guidance

17. British National Formulary for children April 2021; https://bnfc.nice.org.uk/

18. Centre for Perioperative Care. Guideline for Perioperative Care for People with Diabetes Mellitus Undergoing Elective and Emergency Surgery (March 2021). Available at: https://cpoc.org.uk/guidelines-resources/guidelines [Accessed on 8th March 2021]

The guideline would be reviewed every three years, and comments are welcomed on the e-mail below:

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